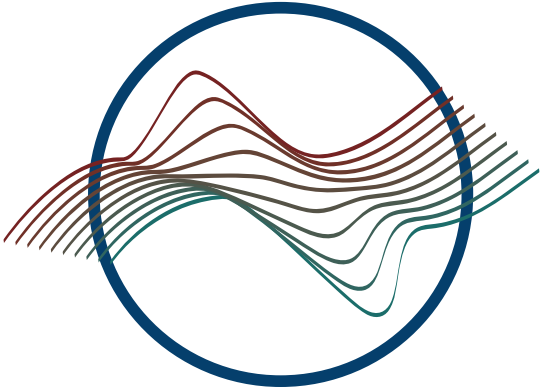
THEOCONTOUR
USER MANUAL



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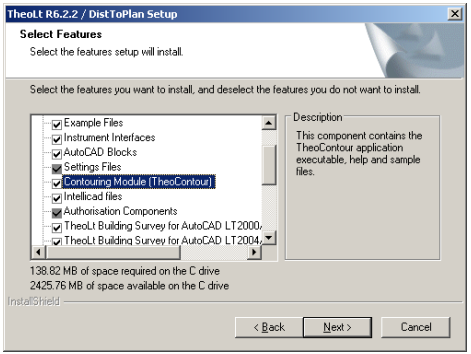
INSTALLATION

TheoContour is distributed as part of the TheoLt product range. The entire range is installed from a single setup during which the various modules may be selected.

TheoLt is distributed in 2 formats:
- CD
- Web Download


TheoLt R6.2.2 / DistToPlan Setup
Select Features
Select the features setup will install.
Select the features you want to install, and deselect the features you do not want to install.
Example Files
Instrument Interfaces
AutoCAD Blocks
Settings Files
Contouring Module (TheoContour)
Intellicad files
Authorisation Components
TheoLt Building Survey for AutoCAD LT2000
TheoLt Building Survey for AutoCAD LT2004
Description
This component contains the TheoContour application executable, help and sample files.
138.82 MB of space required on the C drive
2425.76 MB of space available on the C drive
InstallShield
< Back
Next >
Cancel

When using the CD, selecting "Install TheoLt" from the list of options starts the same installation process as the web download.

The name of the web installation file is: `TheoLt32.exe`. To start this installation, double-click the `TheoLt32.exe` file.

Follow the instruction indicated on the screen

For complete installation of TheoContour only, select the custom installation option when prompted. The following components are required to complete the TheoContour installation (If only TheoContour is required, all other components may be ignored):
- Program Files
- TheoContour
- Settings Files

Note: All examples in this manual (unless specified otherwise) use the file contour-pointsbypoints 2000.dwg which is installed in the application folder.

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Once installed, start AutoCAD

From the Tools Menu, Select Options.

Click the [+] to expand the Support File Search Path.

Click the [Add] button. An empty path will be added to the end of the Support File Search Path list.

Click the [Browse] Button. Use the explorer to find the installation location of TheoContour (usually c:\Program Files\Latimer_CAD\TheoLt or TheoLt R6).

Click [OK].

Click [OK] to close the Options dialog box.

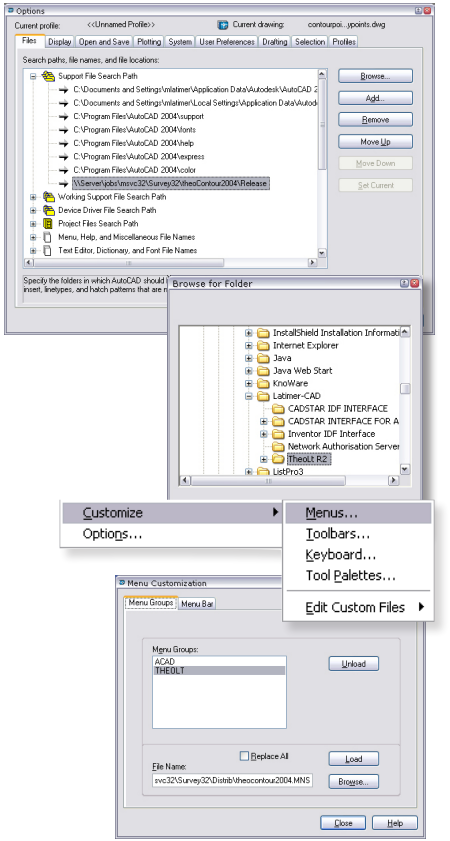
From the AutoCAD Tools menu, Select Customize - Interface or Menus Customize - Menus:

Select the [Menu Groups] tab.

Click [Browse]. From the install folder (as selected above), select the file:

For AutoCAD 2007 `theocontour2007 _ 9.CUI`
For AutoCAD 2004 to 2006: `theocontour2004.MNS`
For AutoCAD 2002 etc: `theocont.MNS`

Click [Load] to load the menu file.



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The THEOLT menugroup should now be listed.

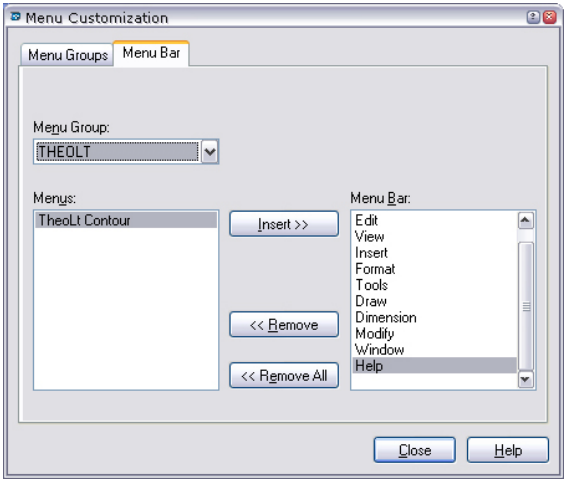
Select the [Menu Bar] tab.

Select THEOLT from the Menu Group list box.

Select TheoLt Contour menu from the menus list.

Select Help in the list on the Menu Bar list. Click [Insert].

[Close] the dialog box.



The menu should be displayed. Additionally, check the command line, loading the menu automatically loads the TheoContour application:

For Example:

```
Command: _ menuload
Menu loaded successfully. MENUGROUP: THEOLT
Command: Initializing VBA System...TheoContour base license avail-
able
Command:
```

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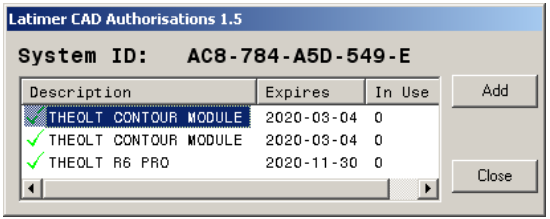
AUTHORISATION

Once installed, start AutoCAD

The installation process should have added the TheoContour Menu to the loaded menus at start-up. If this is not the case, see : Loading the TheoContour Menu.

From the TheoContour pull-down menu select Licence Management.



The Authorisations dialog box will be displayed. Make a note of the System-ID.

Complete the Authorisation Request document (enclosed) and either:

- Fax to 01403 272179

or

- Email to: auths@latimer-cad.com

Once the Authorisation code is supplied, click [Add] . This will display a dialog box in which the Authorisation should be entered. Press [Ok] to complete.

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BASIC CONCEPTS

The process of creating contours is divided into two main actions:
- Selecting the Data
- Creating the Contours (and / or Surface)

Selecting the Data:

TheoContour acts upon AutoCAD point entities.

Note: When running TheoLT real-time contouring, points are automatically added to a single layer and "collated".

The command TheoCollate enables the data to be selected using standard AutoCAD selection techniques. Once the data (points) are selected, the TheoCollate command builds a triangulated surface mesh from the points.

There are no settings that affect the selection of the data or this process.

Note: Selecting a very large number of points (greater than 100,000 may require a few minutes processing time to build the triangulated mesh).

Creating Contours:

The options for controlling the output of the contours are set using the command TheoOptions. The primary controls for Contours include:
- The Interval.
- The Interval of the index Contour.
- The Output layers.

Additionally, there are options to control the accuracy of the contours. The accuracy settings have a large impact on the amount of time taken to process the data. A good working method is to set the accuracy to "Coarse". Check the output settings (intervals), before moving the accuracy towards "fine" until the desired result is achieved. The contours are created by the command TheoContour

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Creating a Surface:

The triangulated mesh surface used to create the contours may also be converted to a surface consisting of AutoCAD 3D faces using the command TheoSurf. This allows further analysis of the topographical features and / or rendering. (Further analysis is available within AutoCAD 2004 and later with the surface being coloured according to height or gradient).

Note: The mesh and therefore surface is highly dependant on the number of points collected. The greater the number of points, the better the mesh (smaller triangles). However, the aim of using real-time contouring is to collect the minimum number of points to describe the surface, (only collecting a higher density of points in areas that require it). Therefore it is important to understand how the data will be used at the time of collection.

Profiles and Sections:

3 Commands are included for section analysis:

- TheoProfile (single profile between 2 points).
- TheoXProfile (multiple profiles through the surface).
- TheoPlotProfilePath (single profile along a path).

Please see the reference section for full details.

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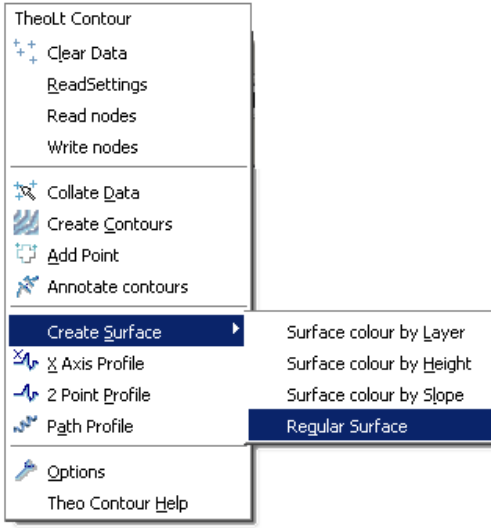
THEOCONTOUR TOOLBAR

TheoContour is installed with both a toolbar and a pull down menu (theocontour007_09.cui) which, when added to the AutoCAD main cui. is availble as part of the main AutoCAD menu.



The toolbar buttons operate the functions (from left to right) below:

1. Collate points
2. Addpoint (real-time capture)
3. Clear points from model
4. Create contours
5. Create surface
6. X Axis profile
7. 2 point profile
8. Path profile
9. Annoate Index contours
10. Settings

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SELECTING DATA TO CONTOUR

Select the Collate icon.

TheoContour will display the current settings on the command line. For Example:

```
Command: theoCollate TheoContour clean-up complete.
TheoContour clean-up complete.
Settings:
Contour Output Layer = Contours
Index Output Layer = Contour _ Idx
Text Output Layer = Contour _ Text
Contour Output Interval = 0.5000
Index Output Interval = 0.1000
TheoContour clean-up complete.
```

After the settings, TheoContour will prompt for points to include in the contour model:

```
Select points to include in the contour model.
```

Any standard AutoCAD selection method may be used (window selection, crossing box or individual picking). In this case, the option ALL has been used to select all of the entities in the drawing. TheoContour will ignore all entities except point entities.

```
Select objects: all
1198 found
Select objects: [enter]
```

TheoContour processes the points to produce a surface. Once the processing is completed, the boundary sizes of the data set is displayed:

```
Building Surface.
Checking Surface
Min point 152.2588, 122.3373, 31.0148
Max point 169.6151, 140.4459, 32.8346
Processed 1198 points,
Boundary Contains 4 points,
Created 2390 surfaces
Allocated 165942098 bytes.
```

Check that the boundary size of the data set is as expected, particularly the maximum and minimum Z values.

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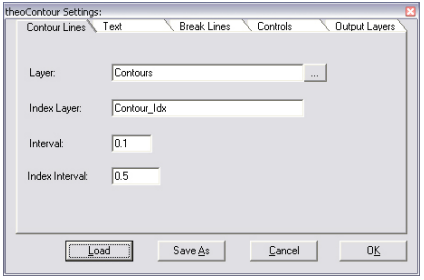
CONTOURING SETTINGS

Layers:

When created, the contours are drawn on pre-set layers and a pre-set interval.



Select the Options Icon.

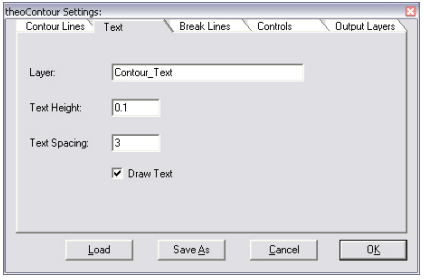
Select the Contour Lines Tab.

2 Layers are used for Contour Lines:

- Basic Contour Lines
- Index Contour Lines

Enter the name of the layer to be used for the Contour lines. If the layer does not exist in the drawing file, it will be created.

The height (Z-value) of the contour Index lines may be annotated along the Index line. This text is placed on a separate layer.



Select the Text Tab. Enter the name of the layer to be used for the Text. If the layer does not exist in the drawing file, it will be created.

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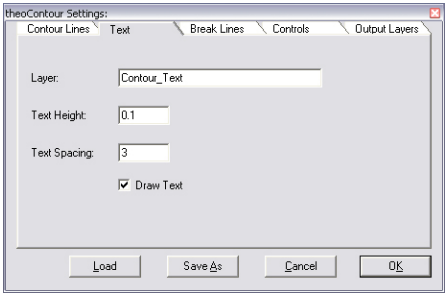
Intervals:

Select the Contour Lines Tab.

Interval specifies the interval for the basic contour lines i.e. for a data set that ranges between the heights of 10M and 12M, setting the interval to 0.5 will create contour lines at heights of: 10, 10.5, 11, 11.5 and 12.



Index Interval:

Index Interval specifies the interval for the index contour lines i.e. for a surface that ranges between the heights of 10M and 12M, setting the Interval to 0.5 and the Index Interval to 2 will create contour lines at heights of: 10.5, 11, 11.5 . Index Lines at 10 and 12. Usually the Index Interval is a multiple of the Interval.

Index Text Spacing:

Select the Text Tab.

The text is placed along the Contour Index lines at the specified interval (this is the minimum spacing, depending on the sample rates and the data set, the text may be spaced further apart).

Note Uncheck the 'Draw text' option if you want to place text using the annotate Index conontours *tool after contour generation.*

TheoContour now has enough data [Ok] to close the options dialog box.

Select the TheoContour Icon.
The contours will be created according to the settings.

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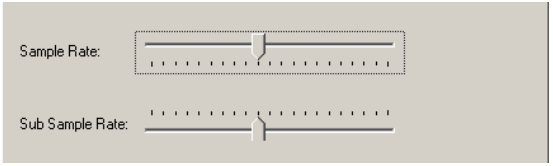
SPEED AND ACCURACY:

The images on the right show contours generated on the same model with differing settings.

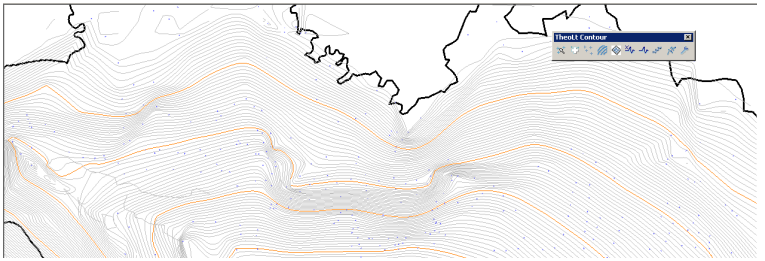
Image 1 2 &3(right)
Top: Sample and Sub-sample at defaults,
Centre: Sample at default sub-sample rate raised
Bottom: Sample and Sub-sample rates raised

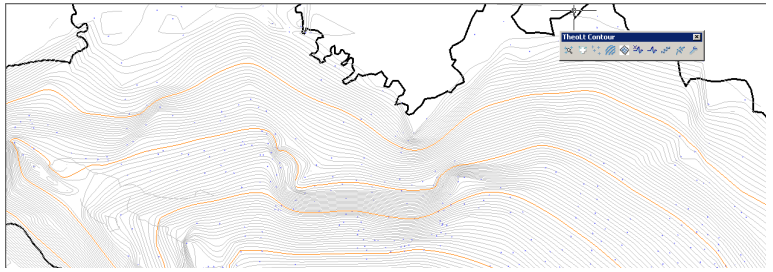
All have identical Interval and Index Interval settings, but the Sample Rate has been altered.

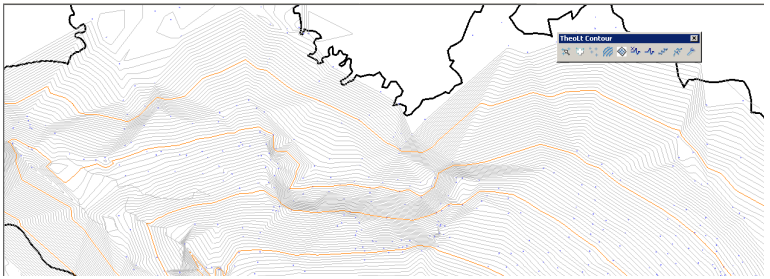
Select the Options Icon. Select the Controls Tab.



Use the Sample rate slider to adjust how TheoContour samples the data. The sampling rate increases to the RIGHT of the slider. The sample rate determines how closely the contours follow the TIN surface of the points. The Sub-sample setting steps across the model in smaller steps, creating finer contour lines, and taking more processing time.







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A further affect on the speed and the accuracy of the results is the type of line used to draw the contour lines.

The images on the right show contours generated on the same model with differing line types.

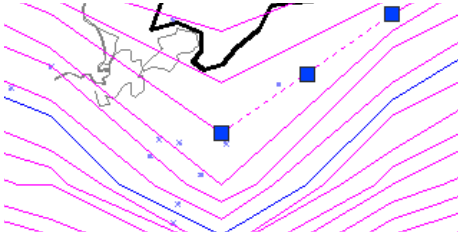
Select the Options Icon.

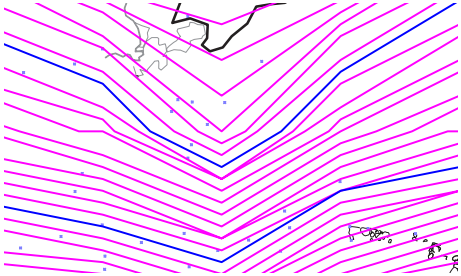
Select the Controls Tab.

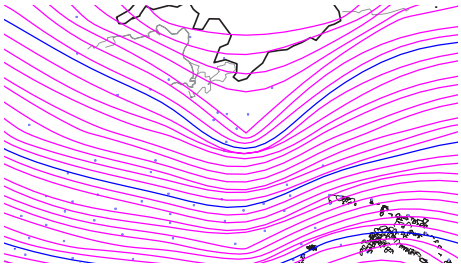
Contour lines can be generated in 3 linetypes:
- Straight Lines
- Straight Polylines
- Splined Polylines

It should be clear from images (right from top :straight lines, straight poly lines and smooth polylines) that the smoothness of the splined polyline gives a nice smooth looking contour line.

The visual difference between creating straight polylines and straight lines are very small. However, contour lines formed from polylines are one continuous line whereas contour lines formed from straight lines consist of many individual line entities.







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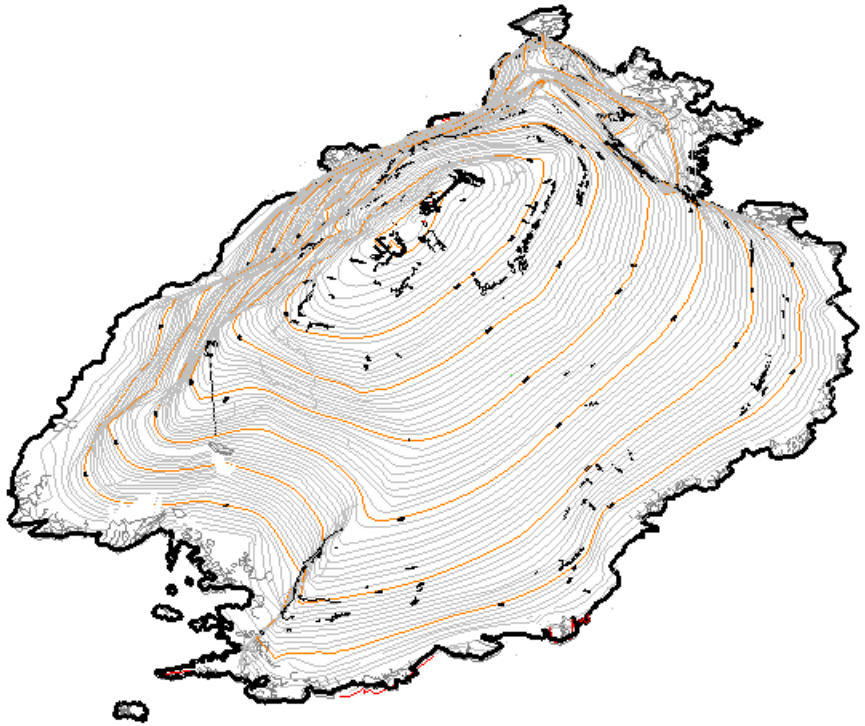
The resultant contours are placed correctly in plan and at the correct Z value, forming a 3D model:



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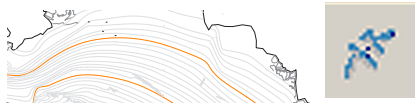
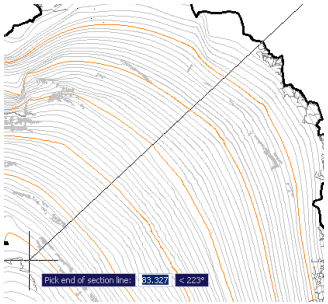
ANNOATE INDEX CONTOURS





The TheoContour version for AutoCAD 2007 has a tool for placing Index contour annotation directly onto the contour model along a user chosen profile. The profile should be picked from low to high to control the orientation of the text (i.e:the text will be facing up slope if the line is sected from bottom to top).The text will be aligned at right angles to the index contour line.

The settings for the command are found in options *and care must be taken to assure the correct layers are used: the layers for both the index contour and the text must be set in options. A current set of option settings needs to be set for TheoContour to find the layers, the setings are read by using ok to quit the options panel, (the prompt to re-contour can be declined).*

Select the comand Annotate index contours and pick the text path line as prompted at the command line

```
Command: theoAnnotateIndexs
Pick start of section line:
Pick end of section line:
```

Note that the 'Draw Text' checkbox in options *should be unchecked to action this command.*

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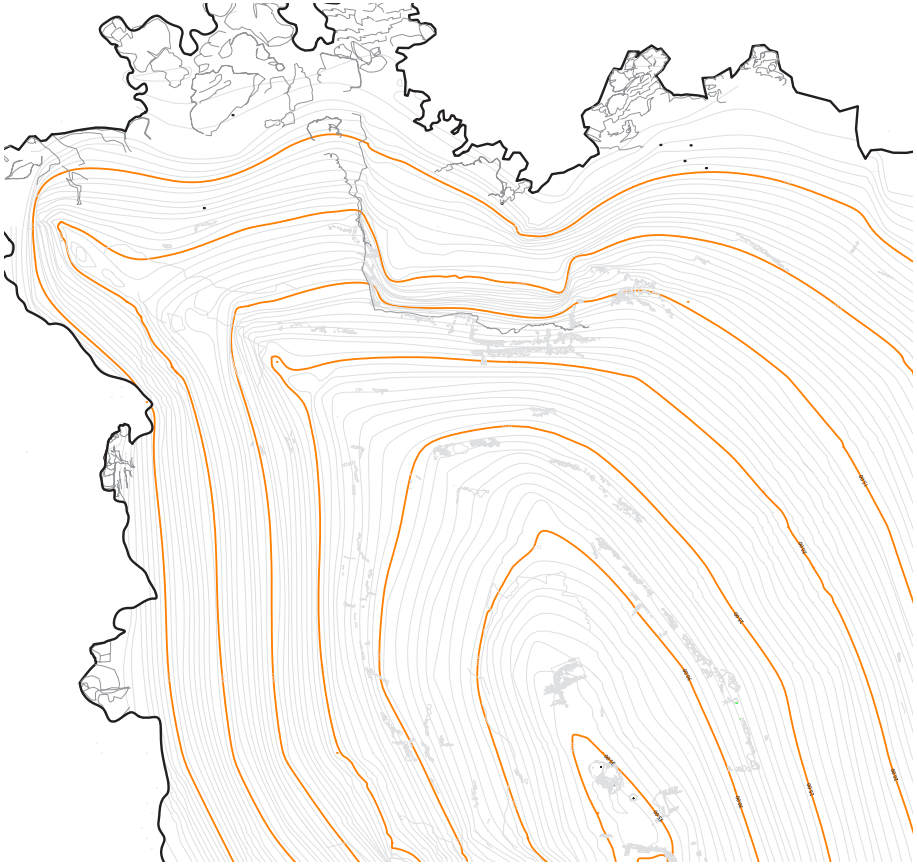
EDITING CONTOUR LINES

Standard AutoCAD commands will allow the user to finesse contour fitting. If Polyline is chosen as the contour type the lines can be smoothed, joined and trimmed as required using `Ploy line edit`.

Breaklines can be incorporated into the contour model by assigning the correct layer in TheoContour options.

Note that contours use the endpoints of lines in the breakline layer as extra points rather than cutlines.Adding points to the enpoints of these lines will cause duplicate point errors.



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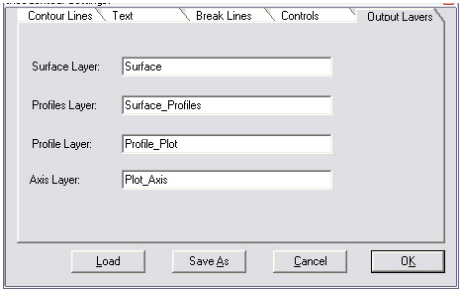
PLOTTING PROFILES

Profiles are section lines taken through the model (also known as cross-sections). The profile is drawn on the current UCS within a labelled axis. Each item making up this profile plot is drawn on it's own layer.



The profile is created by stepping through the model (between 2 points or along a path entity). The plot uses the contour interval setting to control the distance between points on the profile. The profile plot is created using the linetype specified in the Controls tab.

Layers:

Select the Options Icon.

Select the Output Layers Tab.

2 Layers are used for Profile Plots:
- Profile Layer
- Axis Layer

The Profile Layer contains the outline of the profile. The Axis layer contains the Axis and Axis labels.

Enter the name of the layer to be used for each item type. If the layer does not exist in the drawing file, it will be created.

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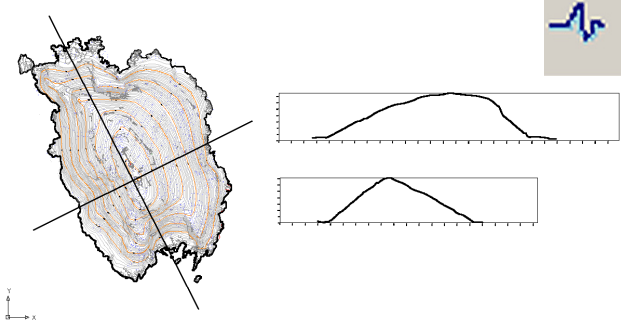
Profile Between 2 Points:

Select the 2 Point Profile Icon

The command prompts for the start and the end points for the profile / section:

```
Command: theoProfile
Pick start of section
line: [pick 1]
Pick start of section line: [pick 2]
```

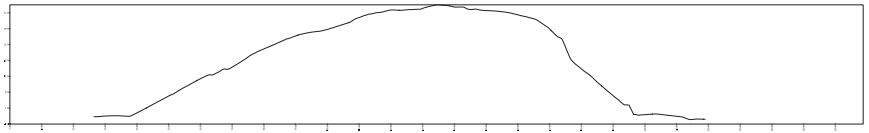


Once the endpoints are selected, position the plot on the correct position:

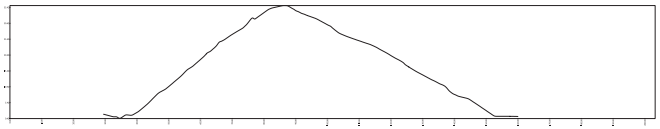
```
Place the plot: [pick 3: Location for the plot]
```

The length and the height of the plot may be scaled to exaggerate the profile if required:

```
Enter Scale for Length of Plot: .5
Enter Scale for Height of Plot: .5
```



Resultant Plot:



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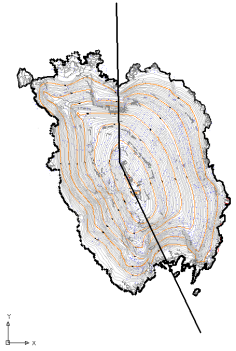
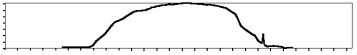
Profile Along a Path :

Select the Path Profile Icon

The command prompts for the an entity to guide the profile /section:

```
Command: THEOPROFILEPATH
Select the Entity to Profile along:
```





The entity may be a polyline (or splined polyline), or a straight line. The Z value (height) of the entity is not important, only the plan position is required.

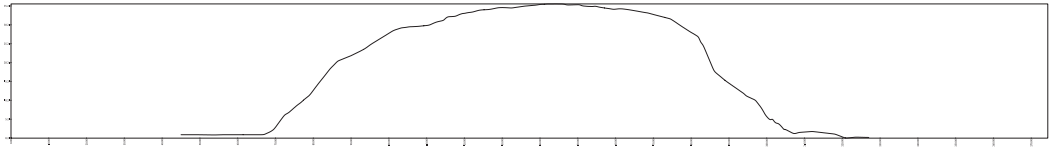
As for the 2 Point Profile, place the plot:

```
Place the plot: [pick Location for the plot]
```

The length and the height of the plot may be scaled to exaggerate the profile if required:

```
Enter Scale for Length of Plot: .5
Enter Scale for
Height of Plot: .5
```

Resultant Plot:



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X-Axis Profile :

Select the **X-Axis Profile** Icon

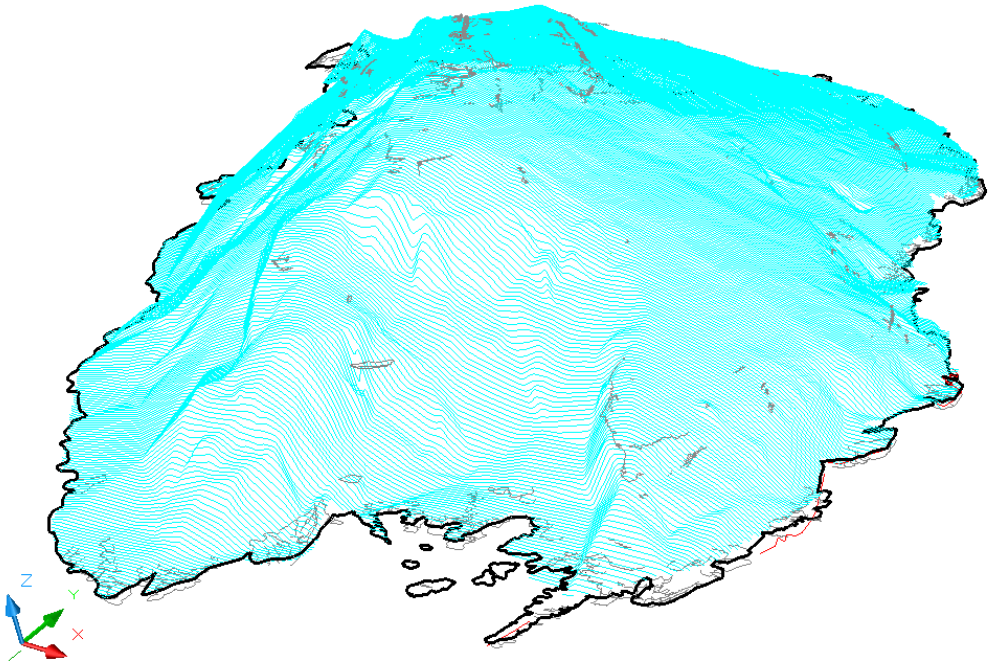
The command will generate a set of vertical profiles across the collated area at the current interval paralell to the X axis of the WCS:

The points will need to be collated before the profiles are created.

A default layer `Surface _ profiles` is created, the layer can be set in **options** ,in the **output layers** tab

```
Command: theoXProfile
```

(Right) The resultant plot:



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SURFACING

For calculating the Contour and Profile lines, TheoContour creates a surface mesh from the point data. This mesh will be converted to AutoCAD 3D faces for rendering and analysis.

The resultant set of faces is created on a pre-set layer:

Layers:

Select the Options Icon.

Select the Output Layers Tab.

The Surface Layer contains the resultant 3D face entities.

Creating the Surface:

Select the Create Surface Icon.

The 3D Faces are created:

```
Command: theosurf Creating Surface
```

Note: If the surface count is large, the time taken to render the surface might be quite long. In this case, a good method is to set AutoCAD to display the drawing in a wireframe mode. Create the surface. Save the drawing and then set the display to rendered.

Note: The example file used in this booklet uses the minimum number of points possible to capture the contour model. Therefore whilst the contour model is a very good match to the real terrain, the surface model, when used for rendering is in fact very poor.

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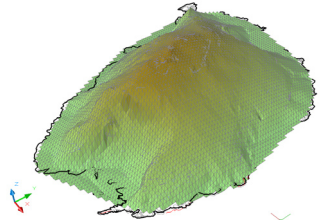
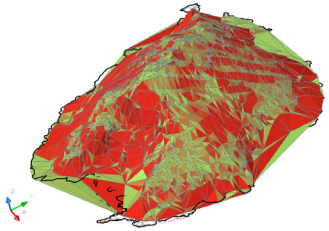
SURFACE TYPES AND SHADING OPTIONS:

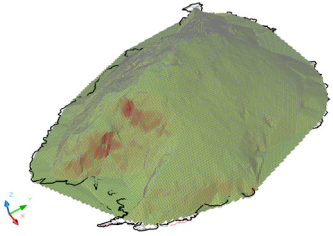
There are 6 options based on the 3 shading methods (slope height or layer) applied to either a regular or irregular TIN. If a regular TIN is selected shading options are prompted atfer setting the vertex interval in the command line. The irregular TIN is generated on selection of the shade type from the pull down menu.



Regular Surface, Coloured by height Iso View. Flat shading



Irregular tin surface, Coloured by slope Iso View. Flat shading



Regular Surface, Coloured by slope Iso View. Flat shading

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REFERENCE SECTION

TheoOptions : Controls

LineType: *Affects commands: TheoContour, TheoProfile, TheoPathProfile*
The contour lines may be drawn as either:
- Straight Lines - each contour line is made of many single straight line segments.
- Straight Polylines - each contour line is a single polyline.
- Splined Polylines - each contour line is a single polyline with the spline option set.

Sample Rate: *Affects commands: TheoContour.*
To create contours, TheoContour "samples" the height of the surface at intervals. Controlling the sample rate of these intervals controls the speed and the detail of the contour lines. See "Speed and Accuracy" for further detail.

Sub Sample Rate: *Affects commands: TheoContour.*
To create contours, TheoContour "samples" the height of the surface at intervals. Controlling the sample rate of these intervals controls the speed and the detail of the contour lines. See "Speed and Accuracy" for further detail.

Local UCS: *Affects commands: TheoCollate.*
Usually, the points collected for contouring are "world coordinates". There may be occasions that TheoContour is used for surfacing points collected for other means (i.e. Buildings). The surfacing tool within TheoContour is not a 3D tool, but a 2D tool. Setting this switch before collation and surfacing / contouring enables TheoContour to work in any orientation within a model.

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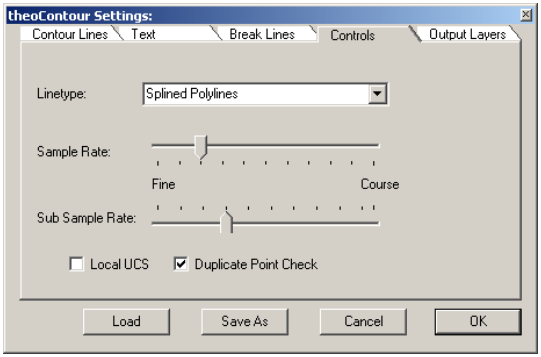
Duplicate Point Check: *Affects commands: TheoCollate.*

A duplicate point is considered to be a point that lies in an X, Y location that is occupied by another point. The points may be at different heights.

Duplicate points within a data set can cause problems for the surfacing (collation) tool. Enabling this option ensures that any duplicate points are ignored. If the output of the TheoContour command appears corrupt, this is usually an indication of a bad surface which may have been caused by duplicate points.

Duplicate point errors are apparent as defects in the contoured surface, TheoContour will attempt to map a recursive surface state when surface facets are bounded more than once.



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TheoOptions : Contour Lines

Layer: *Affects commands: TheoContour.*
Enter the name of the layer to be used for the Basic Contour lines. If the layer does not exist in the drawing file, it will be created.

Index Layer: *Affects commands: TheoContour.*
Enter the name of the layer to be used for the Index Contour lines. If the layer does not exist in the drawing file, it will be created.

Interval: *Affects commands: TheoContour.*
Specifies the interval for the basic contour lines i.e. for a surface that ranges between the heights of 10M and 12M, setting the interval to 0.5 will create contour lines at heights of: 10, 10.5, 11, 11.5 and 12.

Index Interval: *Affects commands: TheoContour.*
Specifies the interval for the basic contour lines i.e. for a surface that ranges between the heights of 10M and 12M, setting the Index interval to 2 will create contour lines at heights of: 10.5, 11, 11.5 and Index Lines at 10 and 12. Usually the Index Interval is a multiple of the Interval.

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TheoOptions : Breakline

Layer: *Affects commands: TheoCollate*
Function: To control the alignment of the surface mesh. Forces the mesh to be coincident with entities (such as lines and polylines) drawn on this layer.

TheoOptions : Text

Layer: *Affects commands: TheoContour.*
Enter the name of the layer to be used for text annotation of the Index lines. If the layer does not exist in the drawing file, it will be created.

Text Height: *Affects commands: TheoContour.*
The text is drawn at the specified character height.

Text Spacing: *Affects commands: TheoContour.*
The text is placed along the Contour Index lines at the specified interval (this is the minimum spacing, depending on the sample rates and the data set, the text may be spaced further apart).

Draw Text: *Affects commands: TheoContour.*
The drawing of text may be disabled.

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TheoOptions : Output Layers

Surface Layer: *Affects commands: TheoSurf.*
Contains the output of the TheoSurf Command.

Profiles Layer: *Affects commands: TheoXProfile.*
Contains the output of the TheoXProfile Command.

Profile Layer: *Affects commands: TheoProfile, TheoProfilePath.*
Contains the profile line (drawn within the axis / box) for the TheoProfile & TheoProfilePath commands.

Axis Layer: *Affects commands: TheoProfile, TheoProfilePath.*
Contains the axis lines and text (drawn around the profile) for the TheoProfile & TheoProfilePath commands.

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TheoCollate

Function: For selecting the AutoCAD points to be used .

Use the standard AutoCAD selection tools to select the point entities to be used for contour data. All other entities are ignored. The collated data is stored internally, the drawing display in AutoCAD is unaltered (i.e. The created mesh is not visible. To create a viewable mesh, use the TheoSurf command afterwards).

Notice that the command reports the extents of the surface model. A good working practice would include the checking of these extents prior to contouring or surfacing. (Check that the height range is as expected to help filter out invalid points).

For Example:

```
Command: theocollate
TheoContour clean-up complete.
Settings:
Contour Output Layer = Contours2004
Index Output Layer = Contour _Idx2004
Text Output Layer = Contour _Text2004
Contour Output Interval = 0.1000
Index Output Interval = 0.5000
TheoContour clean-up complete.
Select points to include in the contour model.
Select objects: all <enter>
7505 found
6233 were filtered out.
Select objects:
Building Surface.
Checking Surface
Min point 400938.3464, 328451.8876, 110.9602
Max point 401167.3585, 328555.3847, 128.3426
Processed 11459 points,
Boundary Contains 4 points,
Created 22912 surfaces
```

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TheoContour

Function: To create contour lines, index lines and contour height annotations.

Note: This command requires the data to be already selected (collated). Use TheoCollate before this command.

Selecting this command processes the collated data according to the current settings (see TheoOptions) . Ensure that the options are set correctly before issuing this command.

The time taken to process the data is wholly dependant on the area covered by the data in relation to the contour interval i.e. processing 1km sq. with an interval of 1M will be faster than processing the same 1km with a contour interval of 0.2M. In addition, reducing the accuracy of the contours (see TheoOptions: Controls) will have a huge effect on the time taken.

After calculating the new contours, any entities currently existing on the layers selected for the contour output will be erased. If a large contour line set exists on these layers, this step may take a little while.

Note: If you wish to keep multiple contour sets, each set must reside on a new layer. Use the TheoOptions command to select the output layers (otherwise, use the AutoCAD Layers command to rename layers).

```
Example:
Command: theocontour
Calculating Contours
Erasing Existing Contours
Drawing Contours
Done!
```


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TheoSurf

Function: To create a visible surface from the collated data.

Note: This command requires the data to be already selected (collated). Use TheoCollate before this command.

Selecting this command processes the collated data according to the current settings (see TheoOptions: Layers). A surface is created in the form of multiple AutoCAD 3D face entities on the selected output layer.

The TheoCollate command report includes the number of surfaces created in the surface mesh. A 3D face entity will be created for each one of these surfaces. If the surface count is large, the time taken to render the surface might be quite long. In this case, a good method is to set AutoCAD to display the drawing in a wireframe mode. Create the surface. Save the drawing and then set the display to rendered.

Command Example:

```
Command: theosurf Creating Surface
```

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TheoProfile

Function: To plot the profile through the model between 2 points.

Starting the command prompts for 2 points, these are either end of the profile to be plotted.
The next prompt is for the location of the plot.
The plot may be scaled in length and height:

For Example:

```
Command: theoProfile
Pick start of section line: [pick 1]
Pick start of section line: [pick 2]
Place the plot: [pick 3: Location for the plot]
Enter Scale for Length of Plot: .5
Enter Scale for Height of Plot: .5
```


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TheoXProfile

Function: Creates multiple profiles through the model.

This commands creates multiple profiles through the model parallel to the X axis of the current UCS. Rotate the UCS about the Z axis to orientate the Profiles in the required direction.

The interval of the sections is controlled by the Contour Interval setting in Options: Lines. There are no command line options for this command.

Example:

```
Command:
Command: theoXProfile
Command:
```

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TheoProfilePath

Function: To plot the profile through the model along a path.

When prompted, select the path for the profile. The path may be any Polyline (curved or straight) or line. The Z value (height) of the entity is not important, only the plan position is required.
The next prompt is for the location of the plot.
The plot may be scaled in length and height:

For Example:

```
Command: THEOPROFILEPATH
Select the Entity to Profile along:
Place the plot:
Enter Scale for Length of Plot: .5
Enter Scale for Height of Plot: .5
```


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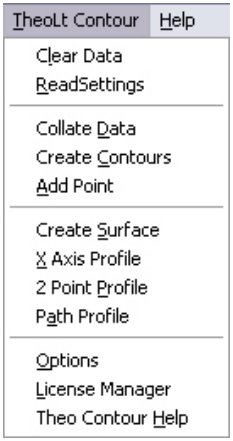
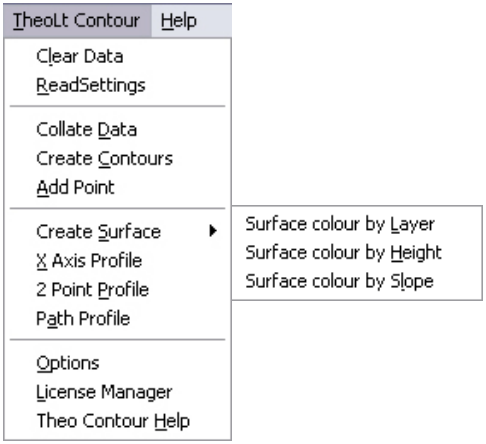
Menu Structure:

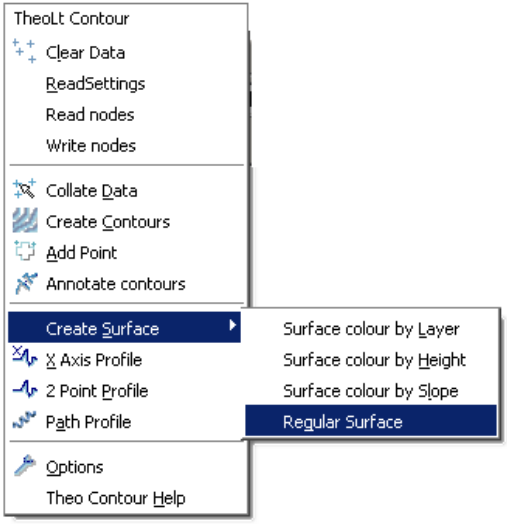
AutoCAD 2000



AutoCAD 2004-06



AutoCAD 2007 on



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